IN THE CLAIMS:

Please amend the claims as follows:

Claims 1-19 (Previously Cancelled).

20. (Currently Amended) An encoded particle, comprising:

a particle substrate;

at least a portion of said substrate being made of a substantially single material and having at least one diffraction grating embedded therein, said grating having a resultant refractive index variation within said single material at a grating location, said refractive index variation comprising a plurality of refractive index pitches superimposed at said grating location; and

said grating providing an output optical signal indicative of a code when illuminated by an incident light signal propagating ~~in free space~~ from outside said substrate, said output optical signal being a result of passive, non-resonant scattering from said grating when illuminated by said incident light signal.

21. (Cancelled) ~~(Previously Presented) The apparatus of claim 20, wherein said refractive index variation comprises at least one refractive index pitch superimposed at said grating location.~~

22. (Cancelled) ~~(Previously Presented) The apparatus of claim 20, wherein said refractive index variation comprises a plurality of refractive index pitches superimposed at said grating location.~~

23. (Previously Presented) The apparatus of claim 20, wherein said substrate is made of a material selected from the group: glass, silica, plastic, rubber, and polymer.

24. (Previously Presented) The apparatus of claim 20, wherein said code comprises a plurality of digital bits.

25. (Previously Presented) The apparatus of claim 20, wherein said code comprises at least a predetermined number of bits, said number being: 3, 5, 7, 9, 10, 12, 14, 16, 18, 20, 24, 28, 30, 40, 50, or 100.

26. (Previously Presented) The apparatus of claim 20, wherein said code comprises a plurality of bits, each bit having a plurality of states.

27. (Previously Presented) The apparatus of claim 20, wherein said code comprises a plurality of bits, each bit having a corresponding spatial location and each bit in said code having a value related to the intensity of said output optical signal at the spatial location of each bit.

28. (Previously Presented) The apparatus of claim 27, wherein the value of each bit corresponds to the magnitude of refractive index variation of a corresponding refractive index pitch in said grating.

29. (Previously Presented) The apparatus of claim 20, wherein said code comprises a plurality of digital bits, each bit having a corresponding spatial location and each bit in said code having a binary value related to the intensity of said output optical signal at the spatial location of each bit.

30. (Previously Presented) The apparatus of claim 29, wherein the value of each bit corresponds to the presence or absence of a corresponding refractive index pitch in said grating.

31. (Previously Presented) The apparatus of claim 20, wherein said incident light signal comprises a substantially single wavelength.

32. (Previously Presented) The apparatus of claim 20, wherein said incident light signal comprises a plurality of wavelengths or a single wavelength scanned over a predetermined wavelength range.

33. (Previously Presented) The apparatus of claim 32, wherein said code comprises a plurality of bits, and each bit in said code having a value related to the intensity of said output optical signal at a wavelength corresponding to each bit.

34. (Previously Presented) The apparatus of claim 33, wherein the value of each bit corresponds to the magnitude of refractive index variation of a corresponding refractive index pitch in said grating.

35. (Previously Presented) The apparatus of claim 32, wherein said code comprises a plurality of digital bits, and each bit in said code having a binary value related to the intensity of said output optical signal at the wavelength corresponding to each bit.

36. (Previously Presented) The apparatus of claim 35, wherein the value of each bit corresponds to the presence or absence of a corresponding refractive index pitch in said grating.

37. (Previously Presented) The apparatus of claim 20, wherein said substrate has a length that is less than a predetermined value, said value being about 30, 65, 80, 125, 250, 500, 750 or 1000 microns.

38. (Previously Presented) The apparatus of claim 20, wherein said substrate has a diameter that is less than a predetermined value, said value being about 30, 65, 80, 125, 250, 500, 750 or 1000 microns.

39. (Previously Presented) The apparatus of claim 20, wherein said substrate has a reflective coating disposed thereon.

40. (Previously Presented) The apparatus of claim 20, wherein said substrate has a coating disposed on at least a portion of said substrate, at least a portion of said coating being made of a material that allows sufficient amount of said incident light signal to pass through said material to allow detection of said code.

41. (Previously Presented) The apparatus of claim 20, wherein said substrate has a coating material disposed on at least a portion of said substrate, said coating comprising a polymer.

42. (Previously Presented) The apparatus of claim 20, wherein said substrate has a magnetic or electric charge polarization.

43. (Previously Presented) The apparatus of claim 20, wherein said substrate has geometry having holes therein or protruding sections therein.

44. (Previously Presented) The apparatus of claim 20, wherein at least a portion of said substrate has an end cross sectional geometry selected from the group: circular, square, rectangular, elliptical, clam-shell, D-shaped, and polygon.

45. (Previously Presented) The apparatus of claim 20, wherein at least a portion of said substrate has a side view geometry selected from the group: circular, square, rectangular, elliptical, clam-shell, D-shaped, and polygon.

46. (Previously Presented) The apparatus of claim 20, wherein at least a portion of said substrate has a 3-D shape selected from the group: a cylinder, a sphere, a cube, and a pyramid.

47. (Previously Presented) The apparatus of claim 20, wherein said substrate has a grating region where said grating is located and a non-grating region where said grating is not located; and wherein said substrate has a plurality of grating regions.

48. (Previously Presented) The apparatus of claim 20, wherein said substrate has a grating region where said grating is located and a non-grating region where said grating is not located; and wherein said grating region has a refractive index that is greater than that of said non-grating region.

49. (Previously Presented) The apparatus of claim 20, wherein said substrate has a grating region where said grating is located and a non-grating region where said grating is not

located; and wherein said grating region has a refractive index that is not greater than that of said non-grating region.

50. (Previously Presented) The apparatus of claim 20, wherein said incident light signal is incident on said substrate along a longitudinal grating axis of said grating.

51. (Previously Presented) The apparatus of claim 20, wherein said incident light signal is incident on said substrate at an angle to a longitudinal grating axis of said grating.

52. (Previously Presented) The apparatus of claim 20, wherein said grating is a thin grating or a blazed grating.

53. (Previously Presented) The apparatus of claim 20, wherein said substrate comprises a plurality of said gratings.

54. (Previously Presented) The apparatus of claim 20, wherein said substrate comprises a plurality of said gratings each at different locations within said substrate.

55. (Currently Amended) A method of reading an encoded particle, comprising:

obtaining a substrate, at least a portion of said substrate being made of a substantially single material and having at least one diffraction grating embedded therein, said grating having a resultant refractive index variation within said single material at a grating location, said refractive index variation comprising a plurality of refractive index pitches superimposed at said grating location;

illuminating said substrate with an incident light signal propagating ~~in free space~~ from outside said substrate, said substrate providing an output optical signal indicative of a code, ~~said code identifying at least one of the element,~~ said output optical signal being a result of passive, non-resonant scattering from said grating when illuminated by said incident light signal; and

reading said output optical signal and detecting said code therefrom.

56. (Cancelled) ~~(Previously Presented) The method of claim 55, wherein said refractive index variation comprises at least one refractive index pitch superimposed at said grating location.~~

57. (Cancelled)~~(Previously Presented) The method of claim 55, wherein said refractive index variation comprises a plurality of refractive index pitches superimposed at said grating location.~~

58. (Previously Presented) The method of claim 55, wherein said substrate is made of a material selected from the group: glass, silica, plastic, rubber, and polymer.

59. (Previously Presented) The method of claim 55, wherein said code comprises a plurality of digital bits.

60. (Previously Presented) The method of claim 55, wherein said code comprises at least a predetermined number of bits, said number being: 3, 5, 7, 9, 10, 12, 14, 16, 18, 20, 24, 28, 30, 40, 50, or 100.

61. (Previously Presented) The method of claim 55, wherein said code comprises a plurality of bits, each bit having a plurality of states.

62. (Previously Presented) The method of claim 55, wherein said code comprises a plurality of bits, each bit having a corresponding spatial location and each bit in said code having a value related to the intensity of said output optical signal at the spatial location of each bit.

63. (Previously Presented) The method of claim 62, wherein the value of each bit corresponds to the magnitude of refractive index variation of a corresponding refractive index pitch in said grating.

64. (Previously Presented) The method of claim 55, wherein said code comprises a plurality of digital bits, each bit having a corresponding spatial location and each bit in said

code having a binary value related to the intensity of said output optical signal at the spatial location of each bit.

65. (Previously Presented) The method of claim 64, wherein the value of each bit corresponds to the presence or absence of a corresponding refractive index pitch in said grating.

66. (Previously Presented) The method of claim 55, wherein said incident light signal comprises a substantially single wavelength.

67. (Previously Presented) The method of claim 55, wherein said incident light signal comprises a plurality of wavelengths or a single wavelength scanned over a predetermined wavelength range.

68. (Previously Presented) The method of claim 67, wherein said code comprises a plurality of bits, and each bit in said code having a value related to the intensity of said output optical signal at a wavelength corresponding to each bit.

69. (Previously Presented) The method of claim 68, wherein the value of each bit corresponds to the magnitude of refractive index variation of a corresponding refractive index pitch in said grating.

70. (Previously Presented) The method of claim 67, wherein said code comprises a plurality of digital bits, and each bit in said code having a binary value related to the intensity of said output optical signal at the wavelength corresponding to each bit.

71. (Previously Presented) The method of claim 70, wherein the value of each bit corresponds to the presence or absence of a corresponding refractive index pitch in said grating.

72. (Previously Presented) The method of claim 55, wherein said substrate has a length that is less than a predetermined value, said value being about 30, 65, 80, 125, 250, 500, 750 or 1000 microns.

73. (Previously Presented) The method of claim 55, wherein said substrate has a diameter that is less than a predetermined value, said value being about 30, 65, 80, 125, 250, 500, 750 or 1000 microns.

74. (Previously Presented) The method of claim 55, wherein said substrate has a reflective coating disposed thereon.

75. (Previously Presented) The method of claim 55, wherein said substrate has a coating disposed on at least a portion of said substrate, at least a portion of said coating being made of a material that allows sufficient amount of said incident light signal to pass through said material to allow detection of said code.

76. (Previously Presented) The method of claim 55, wherein said substrate has a coating material disposed on at least a portion of said substrate, said coating comprising a polymer.

77. (Previously Presented) The method of claim 55, wherein said substrate has a magnetic or electric charge polarization.

78. (Previously Presented) The method of claim 55, wherein said substrate has geometry having holes therein or protruding sections therein.

79. (Previously Presented) The method of claim 55, wherein at least a portion of said substrate has an end cross sectional geometry selected from the group: circular, square, rectangular, elliptical, clam-shell, D-shaped, and polygon.

80. (Previously Presented) The method of claim 55, wherein at least a portion of said substrate has a side view geometry selected from the group: circular, square, rectangular, elliptical, clam-shell, D-shaped, and polygon.

81. (Previously Presented) The method of claim 55, wherein at least a portion of said substrate has a 3-D shape selected from the group: a cylinder, a sphere, a cube, and a pyramid.

82. (Previously Presented) The method of claim 55, wherein said substrate has a grating region where said grating is located and a non-grating region where said grating is not located; and wherein said substrate has a plurality of grating regions.

83. (Previously Presented) The method of claim 55, wherein said substrate has a grating region where said grating is located and a non-grating region where said grating is not located; and wherein said grating region has a refractive index that is greater than that of said non-grating region.

84. (Previously Presented) The method of claim 55, wherein said substrate has a grating region where said grating is located and a non-grating region where said grating is not located; and wherein said grating region has a refractive index that is not greater than that of said non-grating region.

85. (Previously Presented) The method of claim 55, wherein said incident light signal is incident on said substrate along a longitudinal grating axis of said grating.

86. (Previously Presented) The method of claim 55, wherein said incident light signal is incident on said substrate at an angle to a longitudinal grating axis of said grating.

87. (Previously Presented) The method of claim 55, wherein said grating is a thin grating or a blazed grating.

88. (Previously Presented) The method of claim 55, wherein said substrate comprises a plurality of said gratings.

89. (Previously Presented) The method of claim 55, wherein said substrate comprises a plurality of said gratings each at different locations within said substrate.

90. (Previously Presented) The method of claim 55, wherein said incident light signal comprises laser light.

91. (Previously Presented) The apparatus of claim 20, wherein said incident light signal comprises laser light.

92. (Previously Presented) The apparatus of claim 20, wherein said substrate is photosensitive at least at said grating location.

93. (Previously Presented) The method of claim 55, wherein said substrate is photosensitive at least at said grating location.